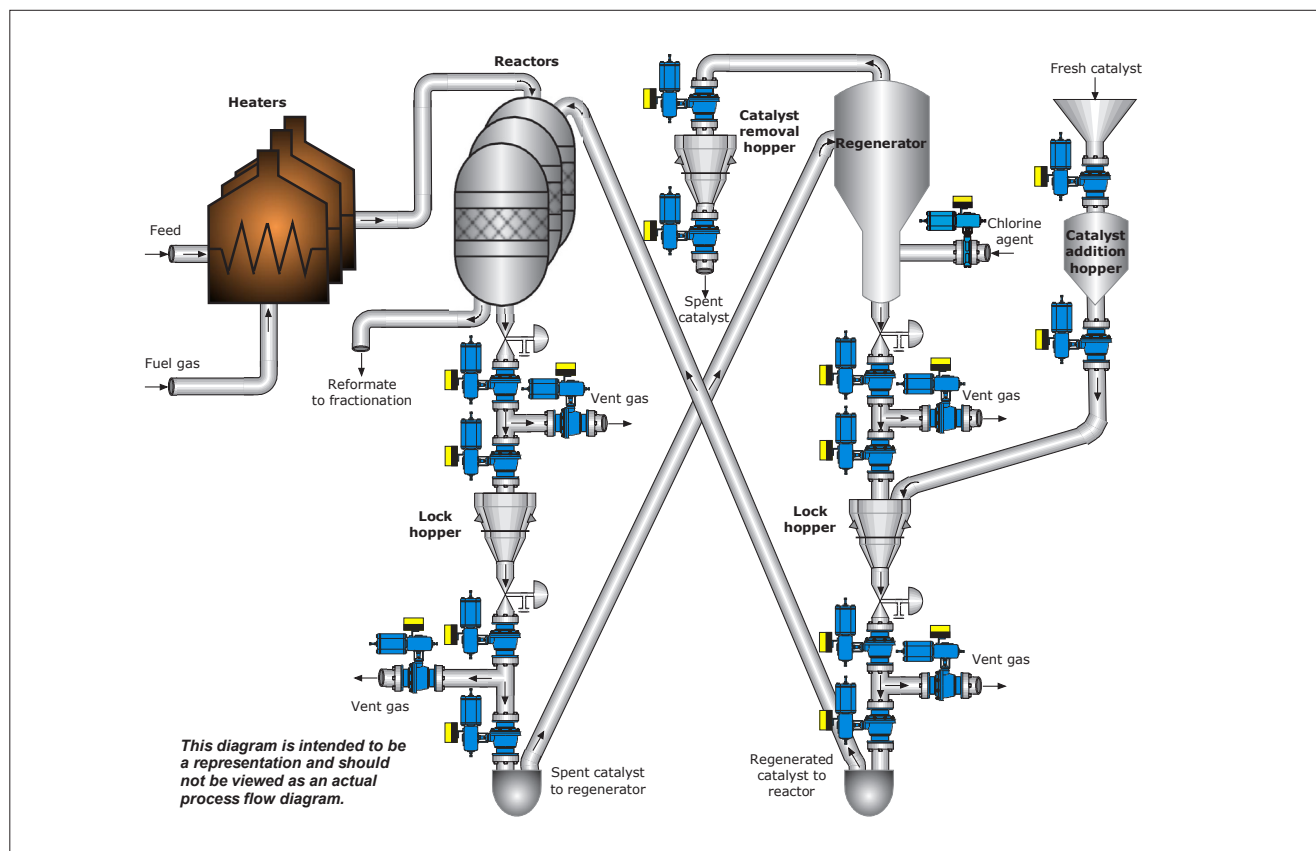


## Continuous catalytic reforming – Catalyst valves



### Process overview

This process can be regarded as the refiner's main tool to control gasoline octane level. The catalytic reformer takes low octane value feedstock and converts it into relatively stable high octane value gasoline blending components. In the process, hydrogen gas is produced as by-product. The excess hydrogen produced by this process is a valuable feedstock to other refinery processes that require additional hydrogen.

The reforming process operates at high temperature levels up to 550 °C (1025 °F). Over a period of time, the catalyst becomes coated with coke, a by-product of the process, and requires regeneration.

Older reformer units use fixed bed reactors in series. Typically, three to four reactor beds are used in a cascade arrangement. These units are referred to as semi-regenerative catalytic reformers. Removing one bed at a time from service and physically opening the reactor and removing and replacing the catalyst achieves regeneration for this type of process.

Modern catalytic reformers use side-by-side or stacked reactors with a continuous catalyst regenerator (CCR), where the catalyst is continuously withdrawn from the reactor, regenerated, and fed back to the stacked reactor bed. A series of lock hoppers, typically four complete lock hopper arrangements, are used to move catalyst from the reactor to the regenerator and eventually back into the reactor.

## Continuous catalyst regeneration valves

In the continuous catalyst regeneration section of the propane dehydrogenation process, there are several valves which isolate the flow of spent or regenerated catalyst between the lock hoppers and the vent valves located beside these.

The catalyst addition and removal hoppers also have on-off valves isolating the flow in and out of the hoppers. Finally, there is also a valve isolating the flow of purifying chlorine agent into the regenerator.

## Lock hopper block and vent valves

The lock hopper block valves are located directly beneath a special segmented ball valve, which blocks the flow of catalyst into the lock hopper between regeneration batches. At first the block valves are open, and when the segmented valve opens, catalyst flows into the lock hopper. Once the lock hopper has been filled, the segmented valve and block valves are closed to isolate the lock hopper. Next, nitrogen is fed into the lock hopper to make the catalyst inert. A fairly large amount of hydrogen is also present in the spent catalyst and the gases are vented through the vent valves after the catalyst has been made inert. Finally the block valves below the hopper are opened and the catalyst flows into a lift engager and transported to the next part of the process.

The lock hopper valves must be able to handle the abrasive catalyst. In addition the valve shouldn't allow catalyst to get pulverized and/or stuck in cavities. The vent valve must vent highly abrasive, catalyst-entrained gas while simultaneously achieving Class VI shut off.



Neles full bore ball valve

## Neles™ solution for lock hopper valves

**Neles X-series full bore metal-seated ball valves.** When equipped with Neles pneumatic cylinder actuators and Neles SwitchGuard™ intelligent on-off valve controllers, they offer a proven performance in lock hopper block and vent valve applications.

- **No pulverization of expensive catalyst**, due to a full-bore design, minimizing the possibility of damage by the abrasive catalyst and saving costs
- **Thermal transient resistant**, due to the body and ball being constructed of A351 CF8M, ensuring the longest possible life and seat to ball tightness
- **Abrasion resistance**, by applying a Nickel Boron coating to the ball and Chromium Carbide (CrC) coating for the seat
- **Neles' unique solids-proof seat**, as the seat back cavity is completely filled with a graphite stack, ensuring that catalyst fines won't accumulate behind the seat increasing the required torque or cause abrasion damage
- **Application compliant**, as the valve meets licensor process requirements such as UOP specification 671

## Valve model example:

### XA03DWUUS6SLJBDD

- XA Full bore seat supported ball valve
- 03 Valve size, typically 2" to 6"
- D ANSI class 300
- W ANSI B16.5 raised face flange
- UU Full compliance with UOP specification 671
- S6 ASTM A351 CF8M / SS 316 stainless steel body construction
- SL SS 316/NiBo ball construction
- J Solids proof seat construction
- B CrC coating on seat
- D All graphite seats and packing with metal stem bearings
- D B8M studs and 8M nuts

## Catalyst addition and removal valves

The catalyst addition system is the point in process where new catalyst is added to replace the quantity of catalyst that is withdrawn and discarded from the system after it can no longer be regenerated. The new catalyst flows by gravity into the system through a catalyst addition hopper at ambient temperature. The new catalyst passes through the first addition valve and into the addition lock hopper. The first valve, above the lock hopper, is then closed and the second valve, below the lock hopper, is opened admitting the new catalyst into the process.

A safety interlock system is needed to prevent both the valve above and below the lock hopper from opening at the same time. Catalyst friendly design and tight-shut off are required. Fire safe design is also often required.

## Neles solution for catalyst addition/removal

The **Jamesbury™ 9150-series soft-seated ball valve** with Xtreme seats, a B1-series pneumatic actuator, and a SwitchGuard valve controller as an option, has been proven to be the right choice by many refineries and petrochemical plants using the continuous catalyst regeneration process.

- **Xtreme™ seat**, a fluoropolymer-based blend, which provides longer life, expanded performance boundaries and greater value
- **Bubble tight shut-off** even after a million cycles, due to the flexible lip seat design which prevents permanent deformation from occurring
- **Cavity relief design**, which diverts the cavity pressure to the least resistance, preventing the valve from being damaged
- **Fire-Tite design**, meeting API 607 and BS6755-Part 2 requirements
- **High torque actuator**, allowing the use of a smaller actuator to achieve tight shut-off
- **Manual override options available**, including a centrepiece handle, a handwheel or a hydraulic override

## Valve model example:

### 3" 9150-31-3600XTZ2

3"	Valve size, typically 2" to 6"
9150	Full bore ANSI Class 150 ball valve
31	Raised face flange, Fire-Tite, seat supported
36	CF8M stainless steel body
00	Ball and stem materials same as body
XTZ	Xtreme seats
2	B8, B8C, B8M or B8T bolts and 8B, 8CB, 8MB, 8TB or 8FB nuts



Jamesbury ball valve

## Chlorine addition valve

Spent catalyst enters the top of the regeneration tower where the coke is burnt off the catalyst at high temperature and low oxygen concentration. Catalyst then passes into the chlorination zone. In this area, the catalyst is oxidized at high temperature and high oxygen concentration in the presence of organic chloride injected into the circulating gas to achieve the proper catalyst chloride balance.

The valve must be able to resist the highly corrosive organic chloride. In addition the valve must achieve bubble-tight shut-off and have low emission packings.

### Neles solution for chlorine addition valve

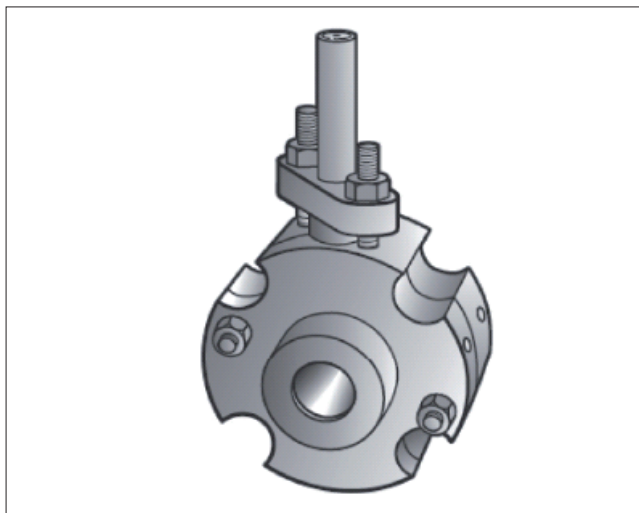
The **Neles W1-series wafer style full bore ball valve** has been specifically designed to meet chlorine application requirements. Equipped with a B1-series pneumatic double acting cylinder actuator, it provides the ideal solution for the control of organic chlorides.

- **Chlorine application design** meeting requirements such as the UOP specification 671
- **Corrosion resistant** as an all Inconel construction is used which is metallurgically compatible with the highly corrosive organic chloride
- **Bubble-tight shut-off** is provided by Teflon seats
- **Wear resistant actuator bearings**, reducing lever arm friction and providing a longer life

### Valve model example:

#### W1BU007IIT01

W1	Full bore wafer style ball valve
B	ANSI 300 dimensions
U	UOP design and construction testing to UOP 671 specification
007	Valve size ¾", 1", or 1½" (typically ¾")
I	Inconel 600 body
I	Inconel 600 stem ball
T	Reinforced PTFE seats
01	PTFE seals

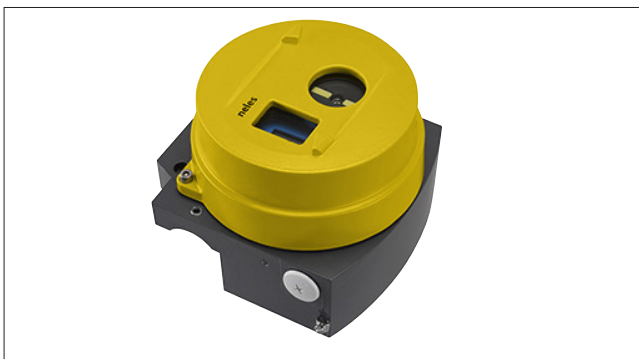


Chloride regeneration isolation valve

## Valve controllers

**Neles' valve controller SwitchGuard SG9000** offers topmost reliability in severe environmental conditions and provides extensive diagnostics for process critical on-off applications, enabling users to guarantee the availability of CCR-valves.

- **Configure to meet process demands** – the SG9000 gives the possibility to set the on-off valve stroking times and profiles according to the process needs
- **Reach fast stroking times without accessories** such as volume boosters or quick exhaust valves, due its high pneumatics capacity
- **Practise predictive maintenance** with the help of the extensive diagnostics that it provides on the CCR-valve performance
- **Simplify the installation** by installing different mechanical or inductive proximity switches inside the SG9000 housing
- **Comprehensive hazardous area certifications** for intrinsically safe and flameproof applications are available for all valve control instruments



SG9000 intelligent valve controller

## Benefits

- Industry and licensor proven performance
- Valves designed to last, saving maintenance costs
- Advanced diagnostics capability in the SG9000 allowing problems to be detected in advance
- Reduce catalyst waste as catalyst won't get stuck in cavities
- Save piping and valve costs with compact and lightweight valve solutions
- Reliable catalyst regeneration improving total process efficiency

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